Product Manual

Pulsar™.2 SATA

ST400FM0012
ST200FM0012
ST100FM0012

100666808
Rev. A
October 2011

Revision history

Revision	Date	Sheets affected or comments
Rev. A	10/19/11	Initial release.

© 2011 Seagate Technology LLC. All rights reserved.

Publication number: 100666808, Rev. A. October 2011

Seagate Technology and the Wave logo are registered trademarks of Seagate Technology LLC in the United States and/or other countries. Pulsar and SeaTools are either trademarks or registered trademarks of Seagate Technology LLC or one of its affiliated companies in the United States and/or other countries. All other trademarks or registered trademarks are the property of their respective owners.

No part of this publication may be reproduced in any form without written permission of Seagate Technology LLC. Call 877-PUB-TEK1 (877-782-8351) to request permission.

When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity may be used for formatting and other functions, and thus will not be available for data storage. Seagate reserves the right to change, without notice, product offerings or specifications.

Contents

Seagate Technology Support Services 1

1.0 Introduction 3
1.1 About the Serial ATA interface 4

2.0 Drive specifications 5
2.1 Specification summary tables 5
2.2 Formatted capacity 7
2.2.1 LBA mode 7
2.3 Default logical geometry for ATA based systems 7
2.4 Performance, Recording and interface technology 7
2.4.1 Interface technology 7
2.4.2 Recording technology 7
2.4.3 Performance 8
2.5 Physical characteristics 8
2.6 Access time 9
2.7 Time to Ready 9
2.8 Power specifications 10
2.8.1 Power consumption 10
2.9 Power dissipation 16
2.9.1 Conducted noise 17
2.9.2 Voltage tolerance 17
2.10 Environmental specifications 18
2.10.1 Temperature 18
2.10.2 Temperature gradient 18
2.10.3 Humidity 18
2.10.4 Altitude 18
2.10.5 Shock 18
2.10.6 Vibration 19
2.11 Electromagnetic immunity 19
2.12 Reliability 20
2.12.1 Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF) 20
2.12.2 Reliability specifications 20
2.13 Agency certification 21
2.13.1 Safety certification 21
2.13.2 Electromagnetic compatibility 21
2.13.3 FCC verification 22
2.14 Environmental protection 23
2.14.1 European Union Restriction of Hazardous Substances (RoHS) Directive 23
2.14.2 China Restriction of Hazardous Substances (RoHS) Directive 23
2.15 Corrosive environment 23

3.0 Configuring and mounting the drive 24
3.1 Handling and static-discharge precautions 24
3.2 Configuring the drive 25
3.3 Serial ATA cables and connectors 25
3.4 Drive mounting 25
3.5 Cooling 27

4.0 Serial ATA (SATA) interface 28
4.1 Hot-Plug compatibility 28
4.2 Serial ATA device plug connector pin definitions 29
4.3 Supported ATA commands 30
4.3.1 Identify Device command 32
4.3.2 Set Features command 39
4.3.3 S.M.A.R.T. commands 40

List of Figures

Figure 1. Typical 400GB model startup and operation current profile 14
Figure 2. Typical 200GB model startup and operation current profile 14
Figure 3. Typical 100GB model startup and operation current profile 15
Figure 4. 400GB models (6Gb) DC current and power vs. input/output operations per second 16
Figure 5. 200GB models (6Gb) DC current and power vs. input/output operations per second 16
Figure 6. 100GB models (6Gb) DC current and power vs. input/output operations per second 17
Figure 7. Attaching SATA cabling 25
Figure 8. Mounting configuration dimensions 26
Figure 9. Air flow 27

Seagate Technology Support Services

For information regarding online support and services, visit http://www.seagate.com/www/en-us/about/contact_us/

Available services include:

- Presales & Technical support
- Global Support Services telephone numbers & business hours
- Authorized Service Centers

For information regarding Warranty Support, visit
http://www.seagate.com/www/en-us/support/warranty_&_returns_assistance

For information regarding data recovery services, visit http://www.i365.com
For Seagate OEM and Distribution partner portal, visit https://direct.seagate.com/portal/system
For Seagate reseller portal, visit http://spp.seagate.com

1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate Pulsar^{TM}.2 model drives:

ST400FM0012 ST200FM0012 ST100FM0012

These drives provide the following key features:

- Multi-Level Cell (MLC) NAND Flash storage.
- High instantaneous (burst) data-transfer rates (up to 600MB/s).
- Parallel flash access channels.
- State-of-the-art on-the-fly error-correction algorithms.
- Native Command Queueing with command ordering to increase performance in demanding applications.
- Highly integrated hardware functions.
- Power loss data protection.
- Data Set Management with Trim Support.
- Silent operation.
- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Supports latching SATA cables and connectors.
- Worldwide Name (WWN) capability uniquely identifies the drive.

1.1 About the Serial ATA interface

The Serial ATA interface provides several advantages:

- Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options.
- Thinner and more flexible cabling for improved enclosure airflow and ease of installation.
- Scalability to higher performance levels.

The Serial ATA interface connects each drive in a point-to-point configuration with the Serial ATA host adapter. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports.

Note. The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate Serial ATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical Serial ATA environment.

The Serial ATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated.

The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices. For additional information about how Serial ATA emulates parallel ATA, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification. The specification can be downloaded from www.serialata.org.

2.0 Drive specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate the following drive models:

ST400FM0012 ST200FM0012 ST100FM0012

Product data communicated in this manual is specific only to the model numbers listed in this manual. The data listed in this manual may not be predictive of future generation specifications or requirements. If you are designing a system which will use one of the models listed or future generation products and need further assistance, please contact your Customer Technical Support Engineer or our global support services group as shown in See “Seagate Technology Support Services” on page 1.

2.1 Specification summary tables

The specifications listed in the following table is for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

Table 1: Drive specifications summary for 400, 200 and 100 GB models

Drive specification	ST400FM0012	ST200FM0012	ST100FM0012
Formatted GB (512 bytes/sector)*	400	200	100
Guaranteed logical block addresses (LBAs)	781,422,768	390,721,968	195,371,568
Emulated Bytes per LBA	512		
Sustained 128KB sequentialread/write data transfer rate (MB/s max)	370/140	370/70	370/35
Peak 128KB sequential read/write data transfer rate (MB/s max)	370/200		370/190
Sustained 4KB Random read/write command rate (IOPs)	40,000/11,000	40,000/5500	40,000/2800
Peak 4KB Random read/write command rate (IOPs)	40,000/15,000		40,000/12,000
Flash Memory Type	NAND MLC		
I/O data-transfer rate (MB/s max)	600		
Height (mm max)	7.00 mm (0.276 in)		
Width (mm max)	70.10 mm (2.760 in)		
Length (mm max)	100.45 mm (3.955 in)		
Weight (max)	100 g (0.220 lb)		
Average latency	206 µs		
Power-on to ready (sec max)	14 sec		
Standby to ready (sec max)	13 sec		
Average LBA access time (µs typ)	~227 µs read; ~120 µs write		
Data Retention (typical minimum at 40°C)	3 months		

Drive specification	ST400FM0012	ST200FM0012	ST100FM0012
Sustainable 4KB Random IOPs for 5 year Endurance (65%/35% R/W 70% Duty Cycle)	23,000		22,000
Startup current (typical) 12V / 5V (peak)	0.34 / 0.47 amps		
Voltage tolerance (including noise)	12V ± 5% / 5V ± 5%		
Case temperature	0° to 60°C (operating) –40° to 70°C (nonoperating)		
Temperature gradient (°C per hour max)	20°C (operating) 20°C (nonoperating)		
Relative humidity	5% to 95% (operating) 5% to 95% (nonoperating)		
Relative humidity gradient	20% per hour max		
Wet bulb temperature (°C max)	28		
Altitude, operating	–60.96 m to 3048 m (–200 ft. to 10,000+ ft.)		
Altitude, nonoperating (below mean sea level, max)	–60.96 m to 12,192 m (–200 ft to 40,000+ ft)		
Operational Shock (max at 0.5ms)	1000 Gs		
Non-Operational Shock (max at 0.5ms)	1000 Gs		
Vibration, random operating	20–2000 Hz: 11.08 Grms		
Vibration, random nonoperating	20–2000 Hz: 11.08 Grms		
Nonrecoverable read errors, max	1 LBA per 10^{16} bits read		
Annualized Failure Rate (AFR)	0.44%		
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp You will be asked to provide the drive serial number, model number (or part number) and country of purchase. After submitting this information, the system will display the warranty information for your drive.		
Lifetime Power cycles	50,000		
Supports Hotplug operation per Serial ATA Revision 2.6 specification	Yes		

*One GB equals one billion bytes when referring to drive capacity. Accessible capacity may vary depending on operating environment and formatting.

2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed LBAs	Emulated LBA Size (Bytes)
ST400FM0012	400GB	781,422,768	512
ST200FM0012	200GB	390,721,968	
ST100FM0012	100GB	195,371,568	

*One GB equals one billion bytes when referring to drive capacity. Accessible capacity may vary depending on operating environment and formatting.

2.2.1 LBA mode

When addressing these drives in LBA mode, all blocks (LBAs) are consecutively numbered from 0 to *n–1*, where *n* is the number of guaranteed LBAs as defined above.

See Section 4.3.1, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137GB.

2.3 Default logical geometry for ATA based systems

Cylinders	Read/write heads	Sectors per track
16,383	16	63

2.4 Performance, Recording and interface technology

2.4.1 Interface technology

	400GB	200GB	100GB
Interface	Serial ATA (SATA-II)		
Interface Speeds Supported	6Gb/s, 3Gb/s, 1.5Gb/s		
Maximum Burst Transfer Rate	600MB/s		
Hot Plug Support	Yes		
Native Command Queuing Support	Yes		
Trim Support	Yes		
Lifetime Endurance Throttling	Yes		

2.4.2 Recording technology

Flash Memory Type	NAND MLC
Emulated LBA Size (Bytes)	512
Native Programmable Page size (User Bytes)	8192
Default transfer alignment offset	0
Typical Data Retention with Power removed (at 40°C)	3 months

2.4.3 Performance

	Notes	400GB	200GB	100GB
Maximum Burst Transfer Rate		600MB/s		
Peak sequential 128KB read/write data transfer rate (MB/s max)	[1]	370/200		370/190
Sustained sequential 128KB read/write data transfer rate (MB/s)	[1]	370/140	370/70	370/35
Peak 4KB random read/write command rate (IOPs)	[2]	40,000/15,000		40,000/12,000
Sustained 4KB random read/write command rate (IOPs)	[2]	40,000/11,000	40,000/5500	40,000/2800
Sustainable 4KB Random combined IOPS for 5 year Endurance (65%/35% R/W, 70% Duty Cycle)	[3]	23,000		22,000

[1] Testing performed at Queue Depth = 32, Sequentially Preconditioned drive, using IOMeter 2006.7.27.
[2] Testing performed at Queue Depth = 32, Randomly Preconditioned drive, using IOMeter 2006.7.27.
[3] Testing performed at Queue Depth = 32, Non-Preconditioned drive, using IOMeter 2006.7.27.

Note. IOMeter is available at http://www.iometer.org/ or http://sourceforge.net/projects/iometer/.
IOMeter is licensed under the Intel Open Source License and the GNU General Public License. Intel does not endorse any IOMeter results.

Peak performance is defined as the typical best case performance that the product will be able to achieve when the product is preconditioned as mentioned and host commands are aligned on 4KB boundaries.

Sustained performance is defined as the typical worst case performance that the product will be able to achieve when the product is preconditioned as mentioned and host commands are aligned on 4KB boundaries. Write values also take into account the worst case performance throttling that may occur to ensure the product meets specified reliability specifications.

Due to the nature of Flash memory technologies there are many factors that can result in values different than those stated in this specification. Some discrepancies can be caused by bandwidth limitations in the host adapter, operating system, or driver limitations. It is not the intent of this manual to cover all possible causes of performance discrepancies.

When evaluating performance of SSD devices, it is recommended to measure performance of the device in a method that resembles the targeted application using real world data and workloads. Test time should also be adequately large to ensure that sustainable metrics and measures are obtained.

2.5 Physical characteristics

Maximum height	7.00 mm (0.276 in)
Maximum width	70.10 mm (2.760 in)
Maximum length	100.45 mm (3.955 in)
Max weight	100 g (0.220 lb)

2.6 Access time

Access measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. The specifications in the table below are defined as follows:

- Page-to-page access time is an average of all possible page-to-page accesses in both directions for a sequentially preconditioned drive.
- Average access time is a true statistical random average of at least 5000 measurements of accesses between programmable pages, less overhead, on a randomly preconditioned drive.

*Typical access times (µs)	Read	Write
Page-to-page	60	120
Average	227	120
Average latency:	206	

Note. These drives are designed to provide the highest possible performance under typical conditions. However, due to the nature of Flash memory technologies there are many factors that can result in values different than those stated in this specification.

2.7 Time to Ready

	ST400FM0012	ST200FM0012	ST100FM0012
Power-on to Ready for non-Media related Commands (sec)	3 (max)		
Power-on to Ready for Media related commands (sec)	14 (max)		
Standby to Ready (sec)	13 (max)		
Ready to power removal (sec)	3 (max)		

Power-on to Ready for non-media related commands is defined as the time that it will take the drive to respond from the application power until it is ready to accept commands from the host that do not require access to the flash media. In some cases the drive may accept media access commands during this time, but the commands will not be completed or status returned to the host until the media can be accessed safely. Commands such as Check Power and Identify are examples of non-media related commands.

Power-on to Ready for media related commands is defined as the time that it will take the drive to respond from the application power until it is ready to accept commands from the host that require access to the flash media. Commands such as FPDMA Read Extended and FPDMA Write Extended are examples of media related commands. This value includes the time needed to charge the Power Loss Data Protection Circuit to a level that is adequate to protect customer data from unexpected power loss

2.8 Power specifications

The drive receives DC power (+12V / +5V) through a native SATA power connector. See Figure 7 on page 25.

2.8.1 Power consumption

Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, at 35°C ambient temperature.

- **Startup power**

  Startup power is measured from the time of power-on to the time that the drive reaches operating condition and can process media access commands.

- **Peak operating mode**

  During peak operating mode, the drive is tested in various read and write access patterns to simulate the worst-case power consumption.

- **Idle mode power**

  Idle mode power is measured with the drive powered up and ready for media access commands, with no media access commands having been received from the host.

- **Standby mode**

  During Standby mode, the drive accepts commands, but not be able to immediately access the media because the drive electronics are in a partial power-down mode.

Table 2: 400GB DC power requirements

		All models		
Parameter		400GB (6.0GB)		
Regulation		+/-5%	+/-5%	
Voltage		+5 V	+12V	
		Current (A)	Current (A)	Power (W)
Average Idle Current	DCx	0.41	0.12	3.49
Standby	DCx	0.36	0.01	1.92
Average Sleep Current	DCx	0.35	0.01	1.87
Maximum Start Current:				
DC (Peak DC)	3σ	0.47	0.34	
AC (Peak AC)	3σ	0.52	1.28	
Delayed Motor Start (DC max)	3σ	0.41	0.01	2.17
Peak Operating Current (random read):				
Typical DC	DCx	0.42	0.17	4.14
Maximum DC	3σ	0.46	0.18	4.46
Maximum DC (peak)	3σ	0.72	0.46	
Peak Operating Current (random write):				
Typical DC	DCx	0.43	0.28	5.51
Maximum DC	3σ	0.48	0.31	6.12
Maximum DC (peak)	3σ	0.76	1.26	
Peak operating current (sequential read):				
Typical DC	DCx	0.49	0.31	6.17
Maximum DC	3σ	0.55	0.33	6.71
Maximum DC (peak)	3σ	0.71	0.59	
Peak operating current (sequential write):				
Typical DC	DCx	0.43	0.46	7.67
Maximum DC	3σ	0.48	0.49	8.28
Maximum DC (peak)	3σ	0.74	1.10	

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase power to operational levels.

Table 3: 200GB DC power requirements

		All models		
Parameter		200GB (6.0GB)		
Regulation		+/-5%	+/-5%	
Voltage		+5 V	+12V	
		Current (A)	Current (A)	Power (W)
Average Idle Current	DCx	0.42	0.12	3.54
Standby	DCx	0.36	0.01	1.92
Average Sleep Current	DCx	0.36	0.01	1.92
Maximum Start Current:				
DC (Peak DC)	3σ	0.45	0.31	
AC (Peak AC)	3σ	0.59	0.70	
Delayed Motor Start (DC max)	3σ	0.40	0.01	2.12
Peak Operating Current (random read):				
Typical DC	DCx	0.45	0.17	4.29
Maximum DC	3σ	0.49	0.18	4.61
Maximum DC (peak)	3σ	0.71	0.45	
Peak Operating Current (random write):				
Typical DC	DCx	0.46	0.28	5.66
Maximum DC	3σ	0.51	0.29	6.03
Maximum DC (peak)	3σ	0.77	1.19	
Peak operating current (sequential read):				
Typical DC	DCx	0.52	0.29	6.08
Maximum DC	3σ	0.59	0.32	6.79
Maximum DC (peak)	3σ	0.85	0.62	
Peak operating current (sequential write):				
Typical DC	DCx	0.46	0.49	8.18
Maximum DC	3σ	0.53	0.50	8.65
Maximum DC (peak)	3σ	0.74	1.08	

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase power to operational levels.

Table 4: 100GB DC power requirements

		All models		
Parameter		100GB (6.0GB)		
Regulation		+/-5%	+/-5%	
Voltage		+5 V	+12V	
		Current (A)	Current (A)	Power (W)
Average Idle Current	DCx	0.42	0.11	3.42
Standby	DCx	0.37	0.01	1.97
Average Sleep Current	DCx	0.37	0.01	1.97
Maximum Start Current:				
DC (Peak DC)	3σ	0.45	0.32	
AC (Peak AC)	3σ	0.58	0.51	
Delayed Motor Start (DC max)	3σ	0.39	0.01	2.07
Peak Operating Current (random read):				
Typical DC	DCx	0.45	0.19	4.53
Maximum DC	3σ	0.48	0.20	4.80
Maximum DC (peak)	3σ	0.75	0.46	
Peak Operating Current (random write):				
Typical DC	DCx	0.46	0.32	6.14
Maximum DC	3σ	0.49	0.34	6.53
Maximum DC (peak)	3σ	0.74	0.95	
Peak operating current (sequential read):				
Typical DC	DCx	0.52	0.28	5.96
Maximum DC	3σ	0.56	0.30	6.40
Maximum DC (peak)	3σ	0.77	0.60	
Peak operating current (sequential write):				
Typical DC	DCx	0.46	0.40	7.10
Maximum DC	3σ	0.50	0.42	7.54

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase power to operational levels.

2.8.1.1 Typical current profiles (400GB model)

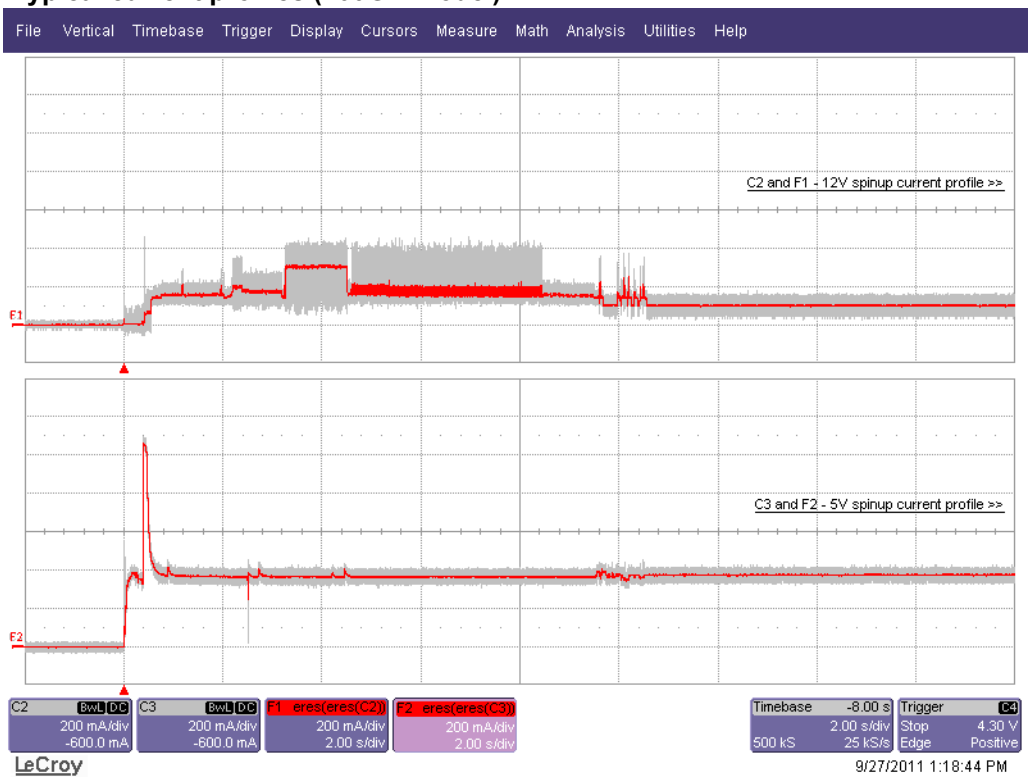

File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
C2 and F1 - 12V spinup current profile >>
C3 and F2 - 5V spinup current profile >>
F1
F2
C2 BwL DC 200 mA/div -600.0 mA
C3 BwL DC 200 mA/div -600.0 mA
F1 eres(eres(C2)) 200 mA/div 2.00 s/div
F2 eres(eres(C3)) 200 mA/div 2.00 s/div
Timebase -8.00 s 2.00 s/div 500 kS 25 kS/s
Trigger C4 Stop 4.30 V Edge Positive
LeCroy
9/27/2011 1:18:44 PM

Figure 1. Typical 400GB model startup and operation current profile

2.8.1.2 Typical current profiles (200GB model)

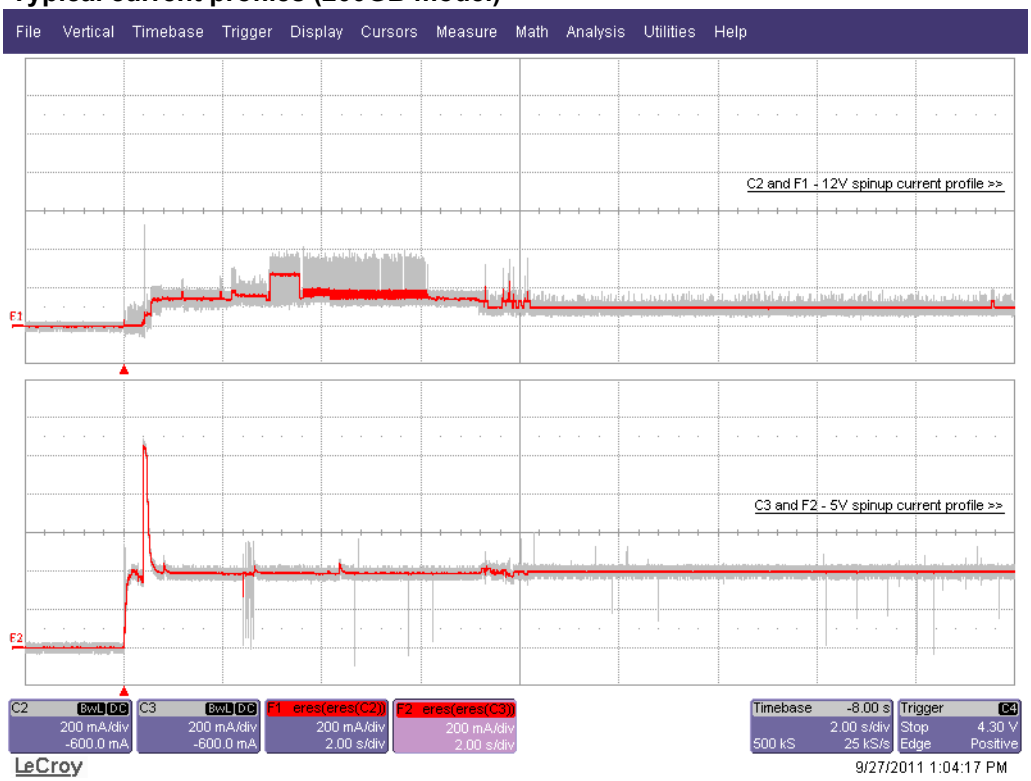

File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
C2 and F1 - 12V spinup current profile >>
C3 and F2 - 5V spinup current profile >>
F1
F2
C2 BwL DC 200 mA/div -600.0 mA
C3 BwL DC 200 mA/div -600.0 mA
F1 eres(eres(C2)) 200 mA/div 2.00 s/div
F2 eres(eres(C3)) 200 mA/div 2.00 s/div
Timebase -8.00 s 2.00 s/div 500 kS 25 kS/s
Trigger C4 Stop 4.30 V Edge Positive
LeCroy
9/27/2011 1:04:17 PM

Figure 2. Typical 200GB model startup and operation current profile

2.8.1.3 Typical current profiles (100GB model)

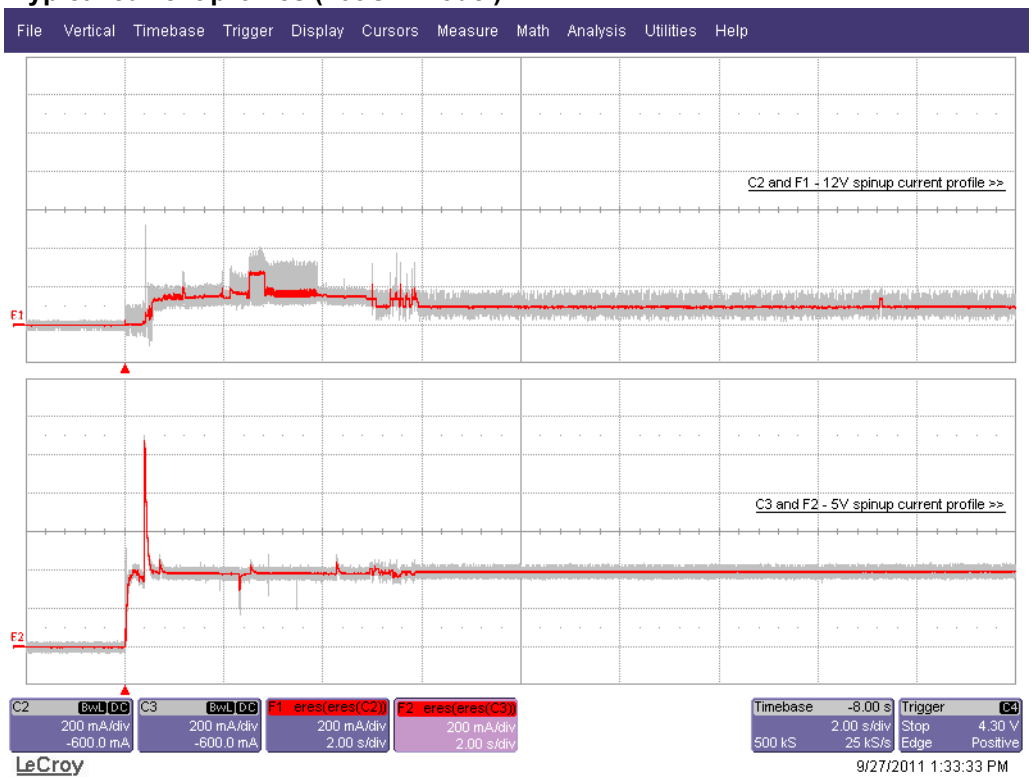

File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
C2 and F1 - 12V spinup current profile >>
F1
C3 and F2 - 5V spinup current profile >>
F2
C2 BwL DC 200 mA/div -600.0 mA
C3 BwL DC 200 mA/div -600.0 mA
F1 eres(eres(C2)) 200 mA/div 2.00 s/div
F2 eres(eres(C3)) 200 mA/div 2.00 s/div
Timebase -8.00 s 2.00 s/div 500 kS 25 kS/s
Trigger C4 Stop 4.30 V Edge Positive
LeCroy
9/27/2011 1:33:33 PM

Figure 3. Typical 100GB model startup and operation current profile

2.9 Power dissipation

400GB models in 6Gb operation

Typical power dissipation under idle conditions in 6Gb operation is 3.49 watts (11.91 BTUs per hour).

To obtain operating power for typical random write operations, refer to the following I/O rate curve (see Figure 4). Locate the typical I/O rate for a drive in your system on the horizontal axis and read the corresponding +5 volt current, +12 volt current, and total watts on the vertical axis. To calculate BTUs per hour, multiply watts by 3.4123.

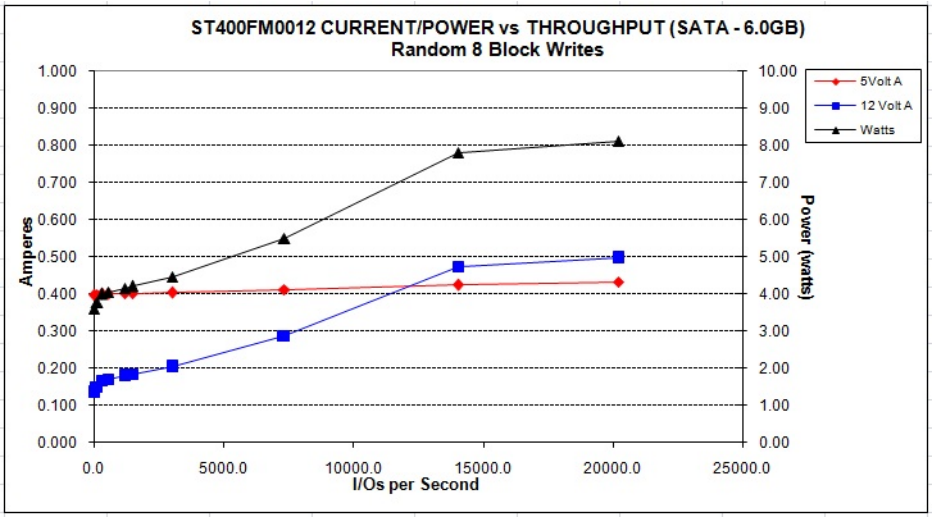


Figure 4. 400GB models (6Gb) DC current and power vs. input/output operations per second

200GB models in 6Gb operation

Typical power dissipation under idle conditions in 6Gb operation is 3.54 watts (12.08 BTUs per hour).

To obtain operating power for typical random write operations, refer to the following I/O rate curve (see Figure 5). Locate the typical I/O rate for a drive in your system on the horizontal axis and read the corresponding +5 volt current, +12 volt current, and total watts on the vertical axis. To calculate BTUs per hour, multiply watts by 3.4123.

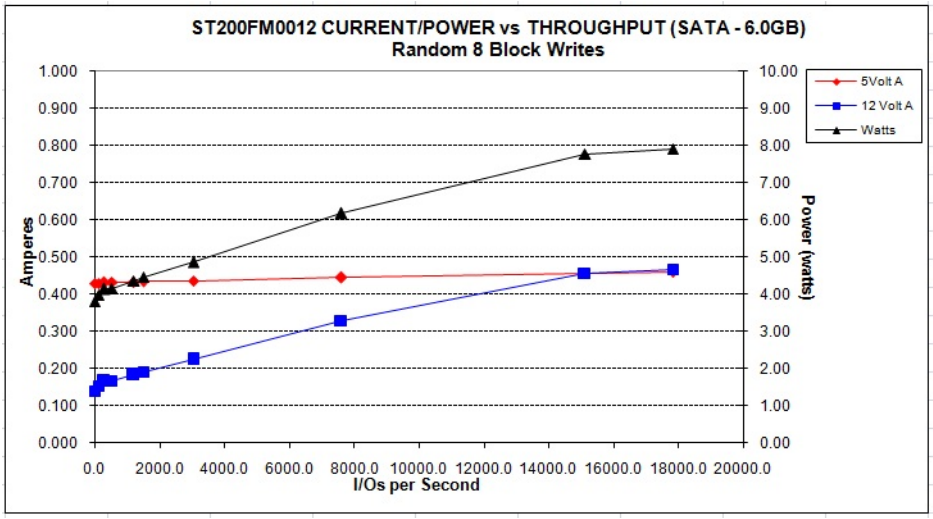


Figure 5. 200GB models (6Gb) DC current and power vs. input/output operations per second

100GB models in 6Gb operation

Typical power dissipation under idle conditions in 6Gb operation is 3.42 watts (11.67 BTUs per hour).

To obtain operating power for typical random write operations, refer to the following I/O rate curve (see Figure 6). Locate the typical I/O rate for a drive in your system on the horizontal axis and read the corresponding +5 volt current, +12 volt current, and total watts on the vertical axis. To calculate BTUs per hour, multiply watts by 3.4123.

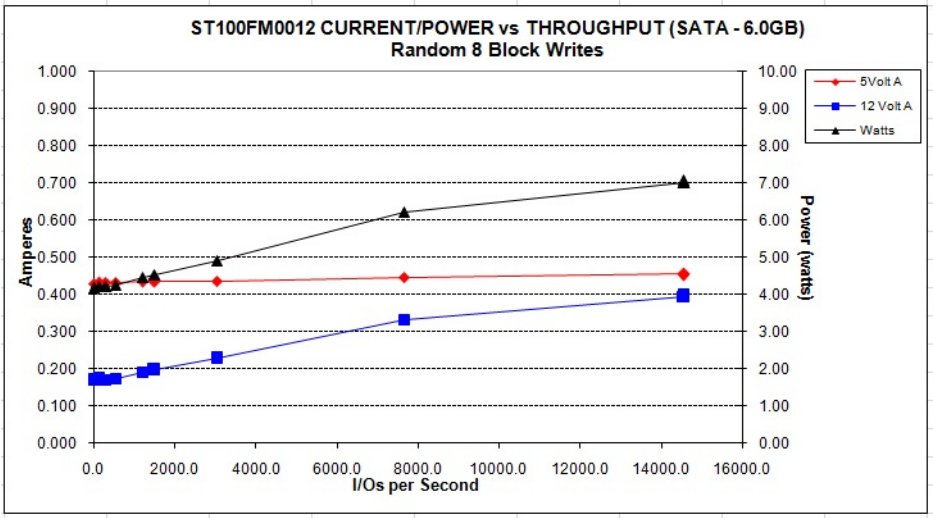


Figure 6. 100GB models (6Gb) DC current and power vs. input/output operations per second

2.9.1 Conducted noise

Noise is specified as a periodic and random distribution of frequencies covering a defined frequency. Maximum allowed noise values given below are peak-to-peak measurements and apply at the drive power connector.

+5v = 250 mV pp from 100 Hz to 20 MHz.

+12v = 450 mV pp from 100 Hz to 100 KHz.
250 mV pp from 100 KHz to 20 MHz.
150 mV pp from 20 MHz to 80 MHz.

2.9.2 Voltage tolerance

Voltage tolerance (including noise):

+12V ±5%
+5V ±5%

2.10 Environmental specifications

2.10.1 Temperature

Temperature is defined as the temperature of the drive case. Actual drive case temperature should not exceed 60°C (140°F).

Above 1000 feet (305 meters), the maximum temperature is derated linearly to 112°F (44°C) at 10,000 feet (3048 meters).

Operating:	0° to 60°C (32° to 140°F)
Nonoperating:	–40° to 70°C (–40° to 158°F)

2.10.2 Temperature gradient

Operating:	20°C per hour (36°F per hour max), without condensation
Nonoperating:	20°C per hour (36°F per hour max)

2.10.3 Humidity

2.10.3.1 Relative humidity

Operating:	5% to 95% noncondensing (20% per hour max)
Nonoperating:	5% to 95% noncondensing (20% per hour max)

2.10.3.2 Wet bulb temperature

Operating:	28°C (82°F max)
Nonoperating:	28°C (82°F max)

2.10.4 Altitude

** Operating:	–60.96 m to 3048 m (–200 ft. to 10,000+ ft.)
** Nonoperating:	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)

** Applies to atmospheric pressure only.

2.10.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

2.10.5.1 Operating shock

These drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 1000 Gs based on half-sine shock pulses of 0.5ms. This specification does not cover connection issues that may result from testing at this level.

2.10.5.2 Nonoperating shock

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 1000 Gs based on a half-sine shock pulse of 0.5ms duration.

2.10.6 Vibration

All vibration specifications assume that the drive is mounted securely with the input vibration applied at the drive mounting screws. Vibration may be applied in the X, Y or Z axis.

2.10.6.1 Operating vibration

The maximum random vibration levels that the drive may experience while meeting the performance standards specified in this document are specified below. This specification does not cover connection issues that may result from testing at this level.

20–2000 Hz	11.08 Grms

2.10.6.2 Nonoperating vibration

The maximum random nonoperating vibration levels that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation are specified below.

20–2000 Hz	11.08 Grms

2.11 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in the following table:

Table 5: Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN 61000-4-2: 95
Radiated RF immunity	80 to 1000 MHz, 3 V/m, 80% AM with 1 kHz sine 900 MHz, 3 V/m, 50% pulse modulation @ 200 Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1 kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1 kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150 kHz to 80 MHz, 3 Vrms, 80% AM with 1 kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

2.12 Reliability

2.12.1 Annualized Failure Rate (AFR) and Mean Time Between Failures (MTBF)

The product shall achieve an Annualized Failure Rate - AFR - of 0.44%. AFR and MTBF are population statistics that are not relevant to individual units.

AFR and MTBF specifications are based on the following assumptions:

- 8760 power-on-hours per year.
- 250 average power cycles per year.
- Operations at nominal voltages.
- Systems will provide adequate cooling to ensure the case temperatures do not exceed specification.

2.12.2 Reliability specifications

Unrecoverable read error rate during	1 LBA per 10^{16} bits read, max
Annualized Failure Rate (AFR)	0.44%
Power cycles	50,000 cycles (at nominal voltage and temperature, with 60 cycles per hour and a 50% duty cycle)
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp You will be asked to provide the drive serial number, model number (or part number) and country of purchase. After submitting this information, the system will display the warranty information for your drive.
Preventive maintenance	None required.
Typical Data Retention with Power removed (at 40°C)	3 months [1]
Endurance	Method 1: 10 Drive Writes per Day [2] Method 2: TBW (per JEDEC JESD218) 400GB = 8800TB 200GB = 4400TB 100GB = 2200TB

[1] As NAND Flash devices age with use, the capability of the media to retain a programmed value begins to deteriorate. This deterioration is affected by the number of times a particular memory cell is programmed and subsequently erased. When a device is new, it has a powered off data retention capability of up to ten years. With use the retention capability of the device is reduced. Temperature also has an effect on how long a Flash component can retain its programmed value with power removed. At high temperature the retention capabilities of the device are reduced. Data retention is not an issue with power applied to the SSD. The SSD drive contains firmware and hardware features that can monitor and refresh memory cells when power is applied.

[2] Endurance is the expected write life of a product when subjected to a specified workload. The drive will support the end user writing the specified multiple of drive user capacity to the drive per day for the expected life of the product. This value is based on randomly writing 4KB transfers aligned on 4KB boundaries across the entire drive LBA range. For example a 200GB drive could be written to up to (n*200GB) of user data per day for the product life.

2.13 Agency certification

2.13.1 Safety certification

These products are certified to meet the requirements of UL60950-1, CSA60950-1 and EN60950 and so marked as to the certify agency.

2.13.2 Electromagnetic compatibility

Drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Seagate uses an independent laboratory to confirm compliance with the EC directives specified in the previous paragraph. Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean KCC

If these drives have the Korean Communications Commission (KCC) logo, they comply with KN22 and KN61000.

Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

2.13.3 FCC verification

These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate Technology LLC has tested this device in enclosures as described above to ensure that the total assembly (enclosure, drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the computer into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.14 Environmental protection

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances.

2.14.1 European Union Restriction of Hazardous Substances (RoHS) Directive

The European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

2.14.2 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.

该产品具有20年的环境保护使用周期 （EPUP）。 下表包含了中国 “电子产品所导致的污染的控制的记号要求”所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements 有毒有害物质或元素					
	Lead 铅（Pb）	Mercury 汞（Hg）	Cadmium 镉（Cd）	Hexavalent Chromium 六价铬（Cr6+）	Polybrominated Diphenyl 多溴联苯（PBB）	Polybrominated Diphenyl Ether 多溴二苯醚（PBDE）
PCBA	X	O	O	O	O	O
CHASSIS	X	O	O	O	O	O

"O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“O”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

2.15 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3.0 Configuring and mounting the drive

This section contains the specifications and instructions for configuring and mounting the drive.

3.1 Handling and static-discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution:

- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive by its edges or frame *only*.
- The drive is fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until you mount it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive.

3.2 Configuring the drive

Each drive on the Serial ATA interface connects point-to-point with the Serial ATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. Both drives behave as if they are Device 0 (master) devices.

Serial ATA drives are designed for easy installation. If you connect the drive and receive a “drive not detected” error, your SATA equipped motherboard or host adapter may use a chipset that does not support SATA 6.0Gb speed autonegotiation. You will need to install a SATA host adapter that supports autonegotiation.

3.3 Serial ATA cables and connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 inches). See Table 6 for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable.

For installations which require cables, you can connect the drive as illustrated in Figure 7.

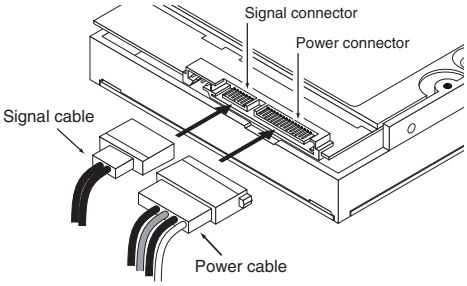


Figure 7. Attaching SATA cabling

Each cable is keyed to ensure correct orientation. Pulsar.2 drives support latching SATA connectors.

3.4 Drive mounting

You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 in (0.76 mm) around the entire perimeter of the drive for cooling as a guideline. Please refer to Section 3.5 for final cooling requirements.
- Use only M3 x 0.5 metric mounting screws.
- Four (4) threads (0.080 in) minimum screw engagement recommended. Also ensure maximum screw length does not bottom out in mounting holes.
- Do not overtighten the mounting screws (maximum torque: 4.5 in-lb, ± 0.45 in-lb).

Refer to Figure 8 for detailed mounting configuration dimensions.
See Section 3.4, “Drive mounting.”

Weight: 0.220 pounds 100 grams

Note. These dimensions conform to the Small Form Factor Standard documented in SFF-8201 and SFF-8223 found at www.sffcommittee.org.

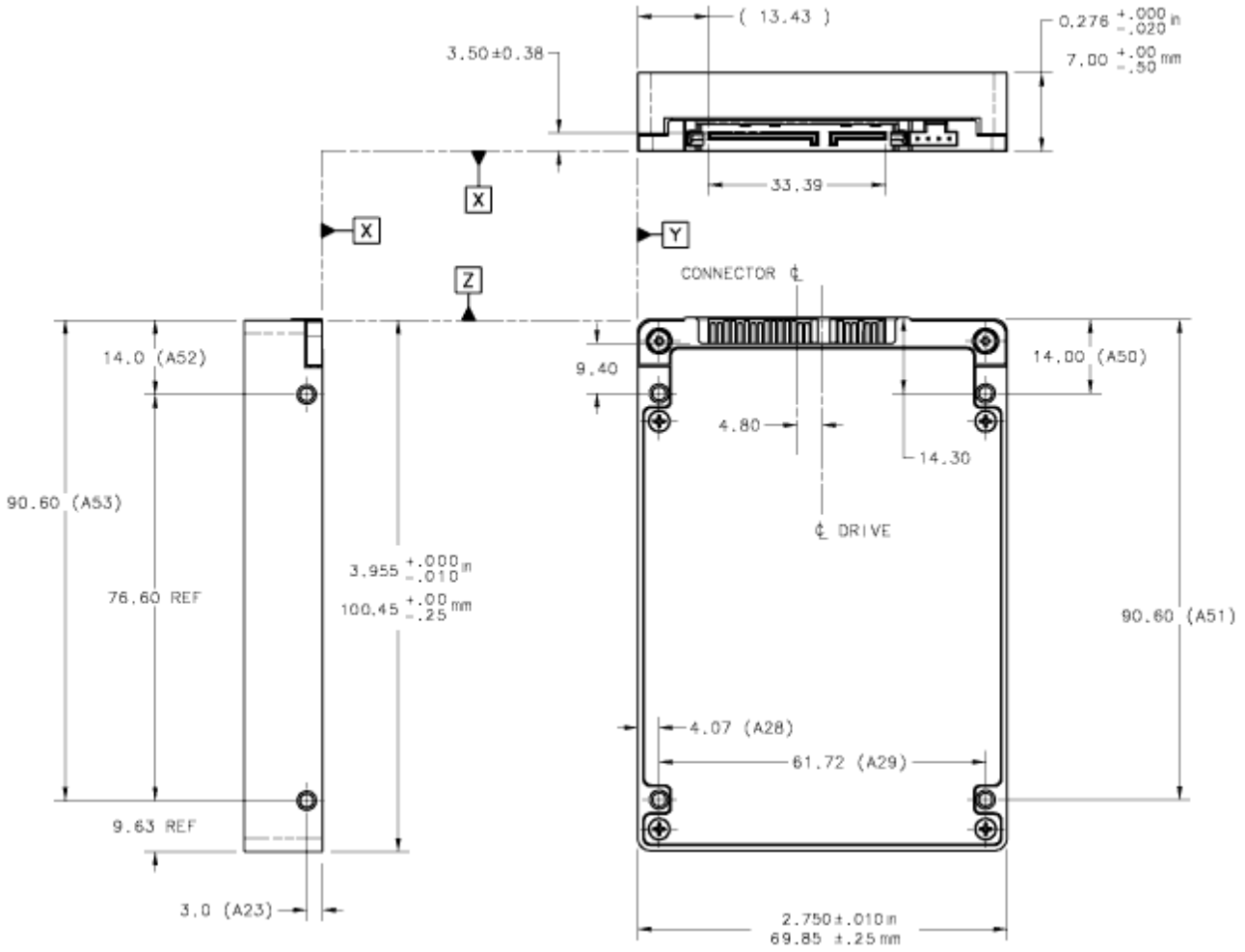


Figure 8. Mounting configuration dimensions

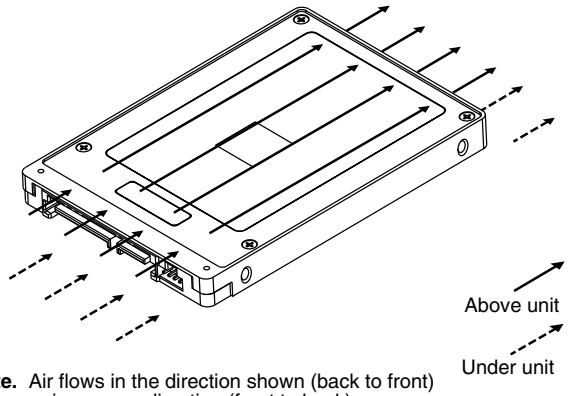
3.5 Cooling

Cabinet cooling must be designed by the customer so that the ambient temperature immediately surrounding the drive will not exceed temperature conditions specified in Section 2.10.1, "Temperature."

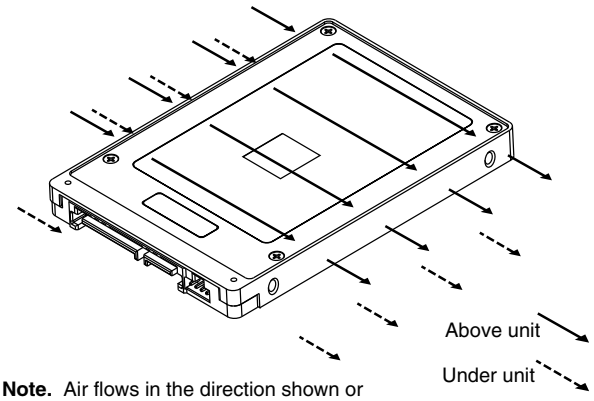
The rack, cabinet, or drawer environment for the drive must provide heat removal. You should confirm that adequate heat removal is provided using the temperature measurement guidelines described in Section 2.10.1.

Forced air flow may be required to keep temperatures at or below the temperatures specified in Section 2.10.1 in which case the drive should be oriented, or air flow directed, so that the least amount of air flow resistance is created while providing air flow to the drive. Also, the shortest possible path between the air inlet and exit should be chosen to minimize the travel length of air heated by the drive and other heat sources within the rack, cabinet, or drawer environment.

If forced air is determined to be necessary, possible air-flow patterns are shown in Figure 9. The air-flow patterns are created by one or more fans, either forcing or drawing air as shown in the illustrations. Conduction, convection, or other forced air-flow patterns are acceptable as long as the temperature measurement guidelines of Section 2.10.1 are met.



Note. Air flows in the direction shown (back to front) or in reverse direction (front to back)



Note. Air flows in the direction shown or in reverse direction (side to side)

Figure 9. Air flow

Image may not represent actual product, for reference only.

4.0 Serial ATA (SATA) interface

These drives use the industry-standard Serial ATA interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–6.

For detailed information about the Serial ATA interface, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification.

4.1 Hot-Plug compatibility

Pulsar.2 drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA II: Extension to Serial ATA 1.0a specification. This specification can be downloaded from www.serial-ata.org.

4.2 Serial ATA device plug connector pin definitions

Table 6 summarizes the signals on the Serial ATA interface and power connectors.

Table 6: Serial ATA connector pin definitions

Segment	Pin	Function	Definition
Signal	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate
Key and spacing separate signal and power segments			
Power	P1	V_{33}	not used
	P2	V_{33}	not used
	P3	V_{33}	not used
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V_5	5V power, pre-charge, 2nd mate
	P8	V_5	5V power
	P9	V_5	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive ignores this signal
	P12	Ground	1st mate.
	P13	V_{12}	+12V power, pre-charge
	P14	V_{12}	+12V power
	P15	V_{12}	+12V power

Notes:

1. All pins are in a single row, with a 1.27 mm (0.050”) pitch.
2. The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are:
   - the ground pins P4 and P12.
   - the pre-charge power pins and the other ground pins.
   - the signal pins and the rest of the power pins.
3. There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.
4. All used voltage pins (V_x) must be terminated.

4.3 Supported ATA commands

The following table lists Serial ATA standard commands that the drive supports. For a detailed description of the ATA commands, refer to the Serial ATA: High Speed Serialized AT Attachment specification. See “S.M.A.R.T. commands” on page 40.for details and subcommands used in the S.M.A.R.T. implementation.

Table 7: Supported ATA commands

Command name	Command code (in hex)
Check Power Mode	$E5_H$
Data Set Management with Trim Support	06_H
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Identify Device	EC_H
Idle	$E3_H$
Idle Immediate	$E1_H$
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read FPDMA Queued	60_H
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H
Read Sectors	20_H
Read Sectors Extended	24_H
Read Verify Sectors	40_H
Read Verify Sectors Extended	42_H
Security Disable Password	$F6_H$
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$
Security Freeze	$F5_H$
Security Set Password	$F1_H$
Security Unlock	$F2_H$
Set Features	EF_H
Set Max Address	$F9_H$

Command name	Command code (in hex)
Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	Address: 00_H Password: 01_H Lock: 02_H Unlock: 03_H Freeze Lock: 04_H
Set Max Address Extended	37_H
Set Multiple Mode	$C6_H$
Sleep	$E6_H$
S.M.A.R.T. Disable Operations	$B0_H$ / $D9_H$
S.M.A.R.T. Enable/Disable Autosave	$B0_H$ / $D2_H$
S.M.A.R.T. Enable Operations	$B0_H$ / $D8_H$
S.M.A.R.T. Execute Offline	$B0_H$ / $D4_H$
S.M.A.R.T. Read Attribute Thresholds	$B0_H$ / $D1_H$
S.M.A.R.T. Read Data	$B0_H$ / $D0_H$
S.M.A.R.T. Read Log Sector	$B0_H$ / $D5_H$
S.M.A.R.T. Return Status	$B0_H$ / DA_H
S.M.A.R.T. Save Attribute Values	$B0_H$ / $D3_H$
S.M.A.R.T. Write Log Sector	$B0_H$ / $D6_H$
Standby	$E2_H$
Standby Immediate	$E0_H$
Write Buffer	$E8_H$
Write DMA	CA_H
Write DMA Extended	35_H
Write DMA FUA Extended	$3D_H$
Write FPDMA Queued	61_H
Write Log Extended	$3F_H$
Write Multiple	$C5_H$
Write Multiple Extended	39_H
Write Multiple FUA Extended	CE_H
Write Sectors	30_H
Write Sectors Extended	34_H
Write Uncorrectable	55_H

4.3.1 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in Table 7 on page 30. All reserved bits or words should be set to zero. Parameters listed with an "x" are drive-specific or vary with the state of the drive. See Section 2.0 on page 5 for default parameter settings.

The following commands contain drive-specific features that may not be included in the Serial ATA specification.

Word	Description	Value
0	General configuration	$0C5A_H$
1	Number of logical cylinders (obsolete) 16,383	$3FFF_H$
2	Specific configuration	$C837_H$
3	Number of logical heads (obsolete) 16	0010_H
4-5	Retired	0000_H
6	Number of logical sectors per logical track (obsolete) 63	$003F_H$
7–8	Reserved for CompactFlash Association	0000_H
9	Retired	0000_H
10–19	Serial number: (ATA ASCII string padded with spaces (20_H))	ASCII
20-21	Retired	0000_H
22	Obsolete	0004_H
23–26	Firmware revision (ATA ASCII string padded with spaces (20h))	ASCII
27–46	Model number (ATA ASCII string padded with spaces (20h))	ASCII
47	(Bits 7-0) Maximum number of logical sectors that shall be transferred per DRQ data block on READ/WRITE MULTIPLE commands. 16	8010_H
48	Reserved for Trusted Computing feature set options	4000_H
49	Capabilities – Standby Timer, IORDY Support, etc	$2F00_H$
50	Capabilities Continued	4000_H
51	PIO data transfer cycle timing option (Obsolete)	0200_H
52	Retired	0200_H
53	Words 54–58, 64–70 and 88 are valid	0006_H
54	Number of current logical cylinders (Obsolete)	$3FFF_H$
55	Number of current logical heads (Obsolete)	0010_H
56	Number of current logical sectors per logical track (Obsolete)	$003F_H$
57–58	Current capacity in sectors (Obsolete)	$FC10_H$ $00FB_H$
59	Number of LBAs transferred per Read Multiple or Write Multiple. Sanitize Command Support	0010_H
60–61	Total number of user addressable logical sectors for 28-bit commands Note: The maximum value allowed in this field is: 0FFFFFFFh. If this field contains 0FFFFFFFh and the device has user addressable LBAs greater than or 137GB, then words 100..103 contain the total number of user addressable LBAs	$XXXXXXXX_H$*
62	Obsolete	0000_H
63	Multiword DMA active and modes supported (see note following this table)	0407_H

Word	Description	Value
64	Advanced PIO modes supported. SATA = 0003h	0003_H
65	Minimum Multiword DMA transfer cycle time per word (120ns)	0078_H
66	Recommended Multiword DMA transfer cycle time (120ns)	0078_H
67	Minimum PIO transfer cycle time without flow control (120ns)	0078_H
68	Minimum PIO transfer cycle time with IORDY flow control (120ns)	0078_H
69	Additional Features and Commands supported. Trim Features supported, DMA commands supported	$5D20_H$
70	Reserved	0000_H
71–74	Reserved for ATAPI	0000_H
75	Queue depth	$001F_H$
76	Serial ATA Capabilities Supported	$850E_H$
77	Reserved for Serial ATA	0004_H
78	Serial ATA features supported	0048_H
79	Serial ATA features enabled	0040_H
80	Major version number	$01F0_H$
81	Minor version number	0029_H
82	Commands and feature sets supported	$346B_H$
83	Commands and feature sets supported	7509_H
84	Commands and feature sets supported	4163_H
85	Commands and feature sets supported or enabled	3469_H
86	Commands and feature sets supported or enabled	$BC01_H$
87	Commands and feature sets supported or enabled	4163_H
88	Ultra DMA support and current mode (see note following this table)	$007F_H$
89	Security erase time	0003_H
90	Enhanced security erase time	0003_H
91	Current APM level value	$FFFE_H$
92	Master password Identifier	0000_H
93	Hardware reset result	0000_H
94	Reserved	$FE00_H$
95–99	ATA-reserved	0000_H
100–103	Total Number of User Addressable Logical Blocks for 48-bit commands. These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh	400GB model = 781,422,768 200GB model = 390,721,968 100GB model = 195,371,568
104	Reserved for Streaming Command Set	0000_H
105	Maximum number of 512-byte blocks of LBA Range Entries (see 4.18.3.2) per DATA SET MANAGEMENT command	0001_H
106	Physical sector size / logical sector size	6004_H
107	Inter-seek delay for ISO 7779 standard acoustic testing	0000_H
108–111	World wide name	$XXXX_H$

Word	Description	Value
112–115	Reserved	0000_H
116	Reserved for TLC	0000_H
117–118	Logical sector size (DWord)	0000_H
119	Commands and feature sets supported	$401C_H$
120	Commands and feature sets supported or enabled	$401C_H$
121–126	Reserved for expanded supported and enabled settings	0000_H
127	Obsolete	0000_H
128	Security status	0021_H
129–159	Vendor specific	$xxxx_H$
160–167	Reserved for the CompactFlash Association	0000_H
168	Device Nominal Form Factor	0003_H
169	DATA SET MANAGEMENT features supported	0001_H
170–173	Additional Product Identifier (ATA String)	0000_H
174–175	Reserved	0000_H
176–205	Reserved	0000_H
206	SCT Command Transport	$10BD_H$
207–208	Reserved for CE-ATA	0000_H
209	Alignment of logical blocks within a physical block	4000_H
210–211	Write-Read-Verify Sector Count Mode 3	0000_H
212–213	Write-Read-Verify Sector Count Mode 2 (DWord)	0000_H
214	NV Cache Capability	0000_H
215-216	NV Cache Size in Logical Blocks (DWord)	0000_H
217	Nominal media rotation rate	0001_H
218	Reserved	0000_H
219	NV Cache Options	0000_H
220	Write-Read-Verify feature set	0000_H
221	Reserved	0000_H
222	Transport major version number	1020_H
223	Transport minor version number	0000_H
224-233	Reserved	0000_H
234	Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h	0000_H
235	Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command for mode 03h	0000_H
236-254	Reserved	0000_H
255	Integrity word ($XXA5_H$)	$xxA5_H$

Note. See the bit descriptions below for words 49, 50, 69, 76, 78, 82-86, 119 and 119-120 of the Identify Drive data.

Description (if bit is set to 1)		
	Bit	**Word 49**
	8	DMA Supported
	9	Shall be set to 1
	10	IORDY May be disabled
	11	IORDY supported
	13	Standby Timer Values supported
	Bit	**Word 50**
	14	Shall be set to 1
	Bit	**Word 69**
	5	Read zero after Trim is supported
	6	Optional ATA 28-bit commands supported
	8	Download Microcode DMA supported
	9	Set Max Password DMA and Set Max Unlock DMA supported
	10	Write Buffer DMA Supported
	11	Read Buffer DMA Supported
	12	DEVICE CONFIGURATION IDENTIFY DMA and DEVICE CONFIGURATION SET DMA are supported
	13	Long Physical Sector Alignment Error Reporting Control is supported
	14	Deterministic read after Trim is supported
	Bit	**Word 76**
	0	Shall be cleared to zero
	1	Supports SATA Gen1 Signaling Speed (1.5Gb/s)
	2	Supports SATA Gen2 Signaling Speed (3.0Gb/s)
	3	Supports SATA Gen3 Signaling Speed (6.0Gb/s)
	4-7	Reserved for Serial ATA
	8	Supports the NCQ feature set
	9	Supports receipt of host initiated power management requests
	10	Supports Phy Event Counters
	11	Supports Unload while NCQ commands are outstanding
	12	Supports NCQ priority information
	13-15	Reserved for Serial ATA
	Bit	**Word 78**
	0	Shall be cleared to zero
	1	Device supports non-zero buffer offsets
	2	Device supports DMA Setup auto-activation
	3	Device supports initiating power management
	4	Device supports in-order data delivery

	5	Reserved for Serial ATA
	6	Device supports Software Settings Preservation
	7-15	Reserved for Serial ATA
	Bit	**Word 82**
	0	The SMART feature set is supported
	1	The Security feature set is supported
	2	Obsolete
	3	Mandatory Power Management feature set is supported
	4	PACKET feature set is supported
	5	Volatile write cache is supported
	6	Read look-ahead is supported
	7	Release interrupt is supported
	8	SERVICE interrupt is supported
	9	DEVICE RESET command is supported
	10	HPA feature set is supported
	11	Obsolete
	12	WRITE BUFFER command is supported
	13	READ BUFFER command is supported
	14	NOP command is supported
	15	Obsolete
	Bit	**Word 83**
	0	DOWNLOAD MICROCODE command is supported
	1	Obsolete
	2	CFA feature set is supported
	3	APM feature set is supported
	4	Obsolete
	5	PUIS feature set is supported
	6	SET FEATURES subcommand is required to spin-up after power-up
	7	Reserved
	8	SET MAX security extension is supported
	9	AAM feature set is supported
	10	48-bit Address feature set is supported
	11	DCO feature set is supported
	12	Mandatory FLUSH CACHE command is supported
	13	FLUSH CACHE EXT command is supported
	14	Shall be set to one
	15	Shall be cleared to zero

	Bit	Word 84
	0	SMART error logging is supported
	1	SMART self-test is supported
	2	Media serial number is supported
	3	Media Card Pass Through Command feature set is supported
	4	Streaming feature set is supported
	5	GPL feature set is supported
	6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported
	7	Obsolete
	8	64-bit World wide name is supported
	9-10	Obsolete
	11-12	Reserved for TLC
	13	IDLE IMMEDIATE command with UNLOAD feature is supported
	14	Shall be set to one
	15	Shall be cleared to zero
	Bit	**Word 85**
	9	DEVICE RESET command is not supported
	10	HPA feature set is supported
	11	Obsolete
	12	WRITE BUFFER command is supported
	13	READ BUFFER command is supported
	14	NOP command is supported
	15	Obsolete
	Bit	**Word 86**
	0	DOWNLOAD MICROCODE command is supported
	1	Obsolete
	2	CFA feature set is supported
	6	SET FEATURES subcommand is required to spin-up after power-up
	10	The 48-bit Address features set is supported
	11	The DCO feature set is supported
	12	FLUSH CACHE command supported
	13	FLUSH CACHE EXT command supported
	15	Words 119..120 are valid
	Bit	**Word 87**
	0	SMART error logging is supported
	1	SMART self-test supported
	3	The Media Card Pass Through Command feature set is supported
	5	The GPL feature set is supported

	6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported
	8	The 64-bit World wide name is supported
	13	The IDLE IMMEDIATE command with UNLOAD FEATURE is supported
	14	Shall be set to one
	15	Shall be cleared to zero
	Bit	**Word 119**
	0	Reserved
	1	Write-Read-Verify feature set is supported
	2	WRITE UNCORRECTABLE EXT command is supported
	3	READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported
	4	DOWNLOAD MICROCODE command with mode 3 is supported
	5	Free-fall Control feature set is supported
	6	Extended Status Reporting feature set is supported
	7	Extended Power Conditions feature set is supported
	8-13	Reserved
	14	Shall be set to one
	15	Shall be cleared to zero
	Bit	**Word 119**
	2	WRITE UNCORRECTABLE EXT command is supported
	3	READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported
	4	DOWNLOAD MICROCODE command with mode 3 is supported
	14	Shall be set to one
	15	Shall be cleared to zero

4.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows:

Table 8: Set Features command values

- 02_H Enable write cache *(default).*
- 03_H Set transfer mode (based on value in Sector Count register).
  Sector Count register values:
  - 00_H Set PIO mode to default (PIO mode 2).
  - 01_H Set PIO mode to default and disable IORDY (PIO mode 2).
  - 08_H PIO mode 0
  - 09_H PIO mode 1
  - $0A_H$ PIO mode 2
  - $0B_H$ PIO mode 3
  - $0C_H$ PIO mode 4 *(default)*
  - 20_H Multiword DMA mode 0
  - 21_H Multiword DMA mode 1
  - 22_H Multiword DMA mode 2
  - 40_H Ultra DMA mode 0
  - 41_H Ultra DMA mode 1
  - 42_H Ultra DMA mode 2
  - 43_H Ultra DMA mode 3
  - 44_H Ultra DMA mode 4
  - 45_H Ultra DMA mode 5
  - 46_H Ultra DMA mode 6
- 10_H Enable use of SATA features
  - 02_H DMA Setup FIS Auto-Activate optimization
  - 03_H Device-initiated interface power state transitions
  - 06_H Software Settings Preservation
- 55_H Disable read look-ahead (read cache) feature
- 66_H Disable reverting to power-on defaults
- 82_H Disable write cache
- 90_H Disable use of SATA features
  - 02_H DMA Setup FIS Auto-Activate optimization
  - 03_H Device-initiated interface power state transitions
  - 06_H Software Settings Preservation
- AA_H Enable read look-ahead (read cache) feature *(default).*
- CC_H Enable reverting to power-on defaults

Note. At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

4.3.3 S.M.A.R.T. commands

S.M.A.R.T. provides near-term failure prediction for drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the *Draft ATA-8 Standard.*

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for $D4_H$) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: http://seatools.seagate.com.

This drive is shipped with S.M.A.R.T. features disabled. You must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Table 9: S.M.A.R.T. commands

Code in features register	S.M.A.R.T. command
$D0_H$	S.M.A.R.T. Read Data
$D2_H$	S.M.A.R.T. Enable/Disable Attribute Autosave
$D3_H$	S.M.A.R.T. Save Attribute Values
$D4_H$	S.M.A.R.T. Execute Off-line Immediate (runs DST)
$D5_H$	S.M.A.R.T. Read Log Sector
$D6_H$	S.M.A.R.T. Write Log Sector
$D8_H$	S.M.A.R.T. Enable Operations
$D9_H$	S.M.A.R.T. Disable Operations
DA_H	S.M.A.R.T. Return Status

Note. If an appropriate code is not written to the Features Register, the command is aborted and 0*x*04 (abort) is written to the Error register.

Index

A

ACA 21
acceleration 19
Access time 9
Agency certification 21
air flow
    illustrated 27
altitude 18
ambient temperature 9, 10
Annualized Failure Rate (AFR) 20
ATA commands 30
Australia/New Zealand Standard AS/NZ CISPR22 21
Australian Communication Authority (ACA) 21
Australian C-Tick 21
Average latency 9
Average seek time 9

C

cables and connectors 25
capacity 7
case temperature 18
CE mark 21
certification 21
Check Power Mode 30
China RoHS directive 23
Class B computing device 22
compatibility 21
Conducted noise 17
Conducted RF immunity 19
Configuring the drive 24
connectors 25
Corrosive environment 23
CSA60950-1 21
cycles 20
Cylinders 7

D

Data Set Management with Trim Support 30
data-transfer rates 3
DC power 10
Default logical geometry 7
dimensions 26
Download Microcode 30
drive mounting 26

E

Electrical fast transient 19
Electromagnetic compatibility 21
Electromagnetic Compatibility Directive (2004/108/EC) 21
Electromagnetic immunity 19
Electrostatic discharge 19
electrostatic discharge (ESD) 24
EN 55022, Class B 21
EN 55024 21
EN60950 21
Environmental specifications 18
ESD 24
EU 21
EU RoHS directive 23
European Union (EU) requirements 21
Execute Device Diagnostics 30

F

FCC verification 22
features 3
Federal Communications Commission 22
Flush Cache 30
Flush Cache Extended 30
Formatted capacity 7

G

geometry 7
Gs 19
guaranteed LBAs 7

H

Handling precautions 24
heads 7
height 8
humidity 18

I

Identify Device 30
Identify Device command 32
Idle 30
Idle Immediate 30
Idle mode 10
Idle mode power 10
Information Technology Equipment (ITE) 21
Initialize Device Parameters 30
interface 7, 28
Interface technology 7
is 9
ITE 21

K

KCC 21
Korean Communications Commission 21
Korean RRL 21

L

latency 9
LBA mode 7
length 8
logical geometry 7

M

maintenance 20
master/slave 4
maximum temperature 18
mounting 25
mounting configuration 26
mounting configuration dimensions 26
mounting screws 18
mounting the drive 24

N

noise 17
nominal power 9
Nonoperating shock 18
Nonoperating vibration 19

O

Operating shock 18
Operating vibration 19

P

Page-to-page 9
Page-to-page access 9
page-to-page accesses 9
Peak operating mode 10
Performance 8
Physical characteristics 8
point-to-point 4, 25
power
    dissipation 16
Power consumption 10
Power specifications 10
precautions 24
printed circuit board 24

Q

quick reference 5

R

Radiated RF immunity 19
Radio and television interference 22
radio frequency (RF) 19
Read Buffer 30
Read DMA 30
Read DMA Extended 30
Read FPDMA queued 30
Read Log Ext 30
Read Multiple 30
Read Multiple Extended 30
Read Native Max Address 30
Read Native Max Address Extended 30
Read Sectors 30
Read Sectors Extended 30
Read Verify Sectors 30
Read Verify Sectors Extended 30
Read/write heads 7
Recording technology 7
relative humidity 18
Reliability 20
RF 19
RoHS 23

S

S.M.A.R.T. Disable Operations 31
S.M.A.R.T. Enable Operations 31
S.M.A.R.T. Enable/Disable Autosave 31
S.M.A.R.T. Execute Offline 31
S.M.A.R.T. implementation 30
S.M.A.R.T. Read Attribute Thresholds 31
S.M.A.R.T. Read Data 31
S.M.A.R.T. Read Log Sector 31
S.M.A.R.T. Return Status 31
S.M.A.R.T. Save Attribute Values 31
S.M.A.R.T. Write Log sector 31
Safety certification 21
SATA 28
screws 18
Seagate Technology Support Services 1
Sectors per track 7
Security Disable Password 30
Security Erase Prepare 30
Security Erase Unit 30
Security Freeze 30
Security Set Password 30
Security Unlock 30
Serial ATA (SATA) interface 28
serial ATA ports 4
Set Features 30
Set Max Address 30
Set Max Address Extended 31
Set Multiple Mode 31
Shock 18
Sleep 31
Specification summary table 5
Standby 31
Standby Immediate 31
Standby mode 10
Startup power 10
static-discharge 24
Surge immunity 19

T

temperature 9, 18
temperature gradient 18
Time to Ready 9

U

UL60950-1 21

V

Vibration 19
Voltage dips, interrupts 19
Voltage tolerance 17

W

weight 8
wet bulb temperature 18
width 8
Write Buffer 31
Write DMA 31
Write DMA Extended 31
Write DMA FUA Extended 31
Write FPDMA queued 31
Write Log Extended 31
Write Multiple 31
Write Multiple Extended 31
Write Multiple FUA Extended 31
Write Sectors 31
Write Sectors Extended 31
write uncorrectable 31

Seagate Technology LLC
AMERICAS Seagate Technology LLC 10200 South De Anza Boulevard, Cupertino, California 95014, United States, 408-658-1000
ASIA/PACIFIC Seagate Singapore International Headquarters Pte. Ltd. 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888
EUROPE, MIDDLE EAST AND AFRICA Seagate Technology SAS 16-18 rue du Dôme, 92100 Boulogne-Billancourt, France, 33 1-4186 10 00

Publication Number: 100666808, Rev. A
October 2011